Preprint
UCRL-JC-140979

Using a Mobile Transparent Plastic-Lead-Boron Shielding Barrier to Reduce Radiation Dose Exposure in the Work Place

S.A. Parra and J.M. Mecozzi

This article was submitted to
2001 international Alara Symposium, Anaheim, CA,
February 3 – 7, 2001

January 11, 2001

U.S. Department of Energy
Lawrence
Livermore
National
Laboratory

Using a Mobile Transparent Plastic-Lead-Boron Shielding Barrier to Reduce Radiation Dose Exposure in the Work Place

S.A. Parra and J.M. Mecozzi
Lawrence Livermore National Laboratory
7000 East Avenue, L-128
Livermore, CA 94551

2001 International ALARA Symposium
Disneyland Hotel
Anaheim, CA
February 3-7, 2001

Using a Mobile Transparent Plastic-Lead-Boron Shielding Barrier to Reduce Radiation Dose Exposure in the Work Place

S.A. Parra and J.M. Mecozzi
Lawrence Livermore National Laboratory

ABSTRACT

Moveable radiation shielding barriers made of plastic material containing lead and boron can be used to reduce radiation exposure near the work place. Personnel can maneuver and position the transparent radiation shielding barriers anywhere within the work place. The lead in the shielding barrier provides an effective shielding material against radiation exposure (approximately a 1.0 mm lead equivalent protection) while the boron in the shielding barrier provides neutron absorption to reduce the moderation/reflection effects of the shielding materials (approximately a 2% $\Delta k/k$ reduction).

INTRODUCTION

Reduction in radiation exposure is difficult to achieve in the plutonium facility due to material restrictions in the storage room. The storage room contains large amounts of fissile material stored in array geometries made up of shelves. Because of possible neutron interaction concerns with the stored fissile material, there are restrictions on the type and amount of materials that can be used inside the storage room. Therefore, personnel working near the array shelves are vulnerable to high radiation exposures. It has been proposed that moveable transparent radiation shielding barriers be used to reduce radiation dose exposures to personnel working near the array shelves.

The moveable transparent radiation shielding barriers are made of plastic material containing lead and boron and are large enough to provide full body protection. Personnel are able to maneuver and position the shielding barriers anywhere within the storage room. The lead in the shielding barrier provides an effective shielding material against radiation exposure while the boron in the shielding barrier provides neutron absorption to reduce the moderation/reflection effects of the shielding materials.

DISCUSSION

The mobile transparent radiation shielding barriers can be made to any dimensions needed and with varying amounts of lead and boron content [1]. However, the transparency of the plastic depends on the amount of lead in the plastic. To maintain a high visibility through the plastic shielding barriers, a 19% lead by weight, which gave a wall thickness of 22 mm, is recommended. A 3% ^{10}B by weight in the shielding barrier is

recommended for moderation/reflection control. Calculations performed using the MCNP4C computer code demonstrate that the lead in the shielding barrier provides a 1.0 mm lead equivalent protection against radiation exposure while the boron provides a 2% Δk/k reduction in neutron absorption due to moderation/reflection effects of the shielding materials [2].

To use any material for moderation/reflection control in the plutonium facility requires meeting criticality safety requirements as stated in ANSI/ANS 8.21-1995 [3]. The following controls are recommended to meet criticality safety requirements:

1. Independently analyze and verify the lead and boron content in the transparent radiation shielding barriers to the material certifications from the manufacturer.

2. Verify correct dimensions upon receipt of the transparent radiation shielding barriers.

3. Prohibit corrosive materials to be used near the transparent radiation shielding barriers.

4. Perform periodic wall thickness measurements on the transparent radiation shielding barriers.

This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.

REFERENCES

[1] Product Specifications, Nuclear Associates, 100 Voice Road, Carle Place, NY 11514.

[2] MCNP - A General Monte Carlo N-Particle Transport Code, Version 4C Manual, Los Alamos National Laboratory, LA-13709-M, March 2000.

[3] ANSI/ANS-8.21-1995, Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors, American Nuclear Society.